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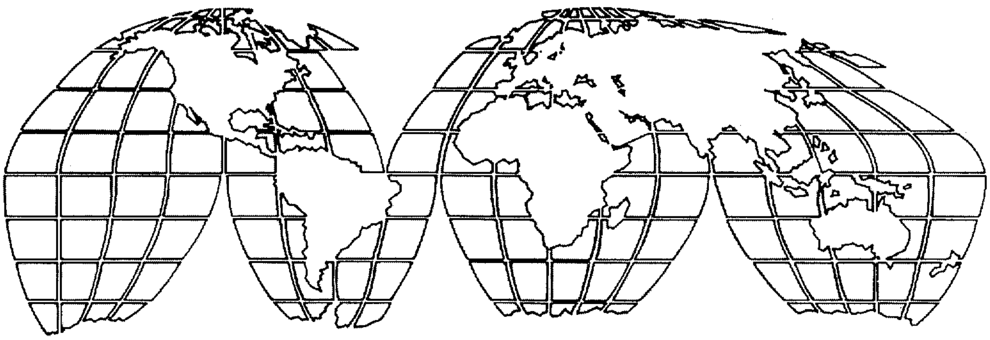
Agriculture and the Environment: Farmers Need Simple Technologies, Secure Tenure, Fast Payback



Center for Development Information and Evaluation
U.S. Agency for International Development (USAID), Washington, D.C. 20523

Summary

Land degradation is looming as a global problem. Between 1975 and the year 2000 the world will have lost 22 percent of its high-potential agricultural land, an area equal in size to Alaska. The loss is alarming, because as population pressures mount, farmers will have to expand onto medium- and low-potential lands. Such lands are both less productive and more fragile and susceptible to degradation.

To combat the problem, USAID during the 1980s spent $645 million on programs in sustainable agriculture—agriculture that conserves and enhances rather than depletes natural resources. The programs have supported activities in improving environmental education and awareness, providing training and institution-building, and encouraging an appropriate policy environment. The keystone of the Agency's programs, though, has been the introduction of appropriate farming technologies.

In 1993–94 USAID's Center for Development Information and Evaluation assessed the Agency's activities in sustainable agriculture in five countries: the Gambia, Jamaica, Mali, Nepal, and the Philippines. In each program evaluated, the Agency had introduced specific conservation technologies designed not only to increase agricultural production but also to reduce soil erosion. All the measures were simple and easily learned. They included terracing, tree-planting, and constructing various types of erosion barriers.

The evaluation found positive socioeconomic and environmental results, to varying degrees, in each country. All countries experienced increased production. Livelihoods and social security were improved. Soil loss was prevented or reduced, and previously uncultivable land restored to farming.

All the technologies are replicable. The practices work well, are not complicated, and can be successfully extended to other areas with similar environmental problems and agroclimatic conditions.

But improved technologies are of little lasting value without the institutions necessary to sustain and promote them. Therein lies the weak link in these programs. Inadequate institutions, particularly local ones, jeopardize the long-term sustain-

ability of the farming practices introduced. This is an area the Agency should target for improvement if the very real strides it has made in soil and water conservation are to continue into the 21st century.

Background

Soil degradation and productivity losses are occurring faster than new land is being brought into production. Between 1975 and the year 2000 the world will have lost 600,000 square miles, or 22 percent, of its high-potential agricultural land. Moreover, degradation of land, coupled with increased population, is reducing the amount of productive land per capita—from 0.3 hectares in 1986 to an estimated 0.23 hectares by the year 2000. Because remaining productive land is under increasing pressure, farmers will be forced to expand onto marginal and environmentally fragile lands. It will become even more difficult to increase food and fiber production to keep pace with population growth while protecting the natural resource base.

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Soil degradation has four major causes: deforestation, overgrazing, agricultural activities, and overexploitation. Deforestation is the main cause of soil degradation in Asia and South America. In Africa, overgrazing is the main threat. In North America it's agricultural activities. Overexploitation is a relatively minor cause of soil degradation in all four regions.

Although worldwide trends in soil degradation are clear, specific actions needed to halt or reverse those trends are not. The actions vary among regions, because biophysical characteristics of land degradation vary. Those characteristics include soil erosion (due to wind and water), loss of soil fertility (from leaching and acidification), loss of plant cover (the main effect of desertification), loss of moisture-holding capacity (largely due to loss of organic matter), development of impermeable subsurface layers (hardpans), and loss of plant diversity.

Farmers are among the first affected by such biophysical changes. But the social and economic circumstances under which farmers operate are as important as, and often more complex than, the biophysical problems they face. Indeed, many experts view soil degradation as a many-faceted socioeconomic rather than biophysical problem.

Among the factors affecting agriculture is population growth, which increases demand for land on which to grow crops. This often leads to deforestation or shorter fallow periods. Continuous cropping increases demand for fertilizer to maintain soil quality.

At the same time, shortsighted economic policies often encourage the clearing of new land for cultivation, rather than protecting and improving land already under cultivation. Moreover, insecure land tenure arrangements discourage farmers from making long-term investments so often needed to conserve resources. What's more, farmers are sometimes not even aware of the benefits of protecting their resource base.

During the 1980s USAID authorized almost $1.1 billion to support various types of environmental activities in the developing countries. Sustainable agriculture activities absorbed $645 million, 60 percent of the total. Nearly half the money for sustainable agriculture supported activities in Africa (47 percent), and almost as much (44 percent) supported activities in Asia and Latin America and the Caribbean combined (23 percent and 21 percent, respectively); the remainder (9 percent) was authorized for the Near East and for centrally funded (global) projects.

Program Elements

In each of the five country programs surveyed for this assessment, USAID introduced specific conservation technologies. These technologies were designed not only to increase agricultural production but also to reduce soil erosion. The Agency also supported three other kinds of interventions that help to explain program impact: improving environmental education and awareness, providing training and institution-building, and encouraging an appropriate policy environment.

Introduction of appropriate technology, though, was the most important of these interventions. It was fundamental in explaining the relative success or failure of each of the programs.

Technological Change

Improved technology is crucial to ensuring environmentally sound agricultural production. A broad range of soil and water conservation technologies are available "on the shelf," and in most cases the techniques are well understood, work well, and bring predictable results—whether they involve terraces, composting, tree-planting, saltwater intrusion dikes, or some other technique. The key is getting farmers to implement them, and here the human element comes into play. In addition to doing the job, the improved technology must satisfy several other conditions. Most important of these, it must provide an economic benefit, usually one with a short-term payoff.

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Saltwater barriers and water retention dams in **the Gambia** were highly successful, because 1) they permitted uncultivable land to be brought back into production to grow a crop (rice) that was particularly important to the community and 2) rice yields increased significantly. Less readily embraced were terraces, contour plowing, and grass waterways in upland areas. They resulted in smaller yield increases, and the payoff materialized only over 5 to 10 years.

Rock lines in **Mali** also were a successful technology. USAID's contribution was to organize farmers to help one another install and maintain these erosion barriers, which are more effective when an entire hillside is lined rather than individual fields. The concept was easy to understand, the technology was easy to learn, and farmers saw a rapid yield response in the first season after investing their labor to construct the rock lines. In contrast, stabling livestock and developing manure pits was less successful and adoption less widespread. The practice is more appropriately targeted to livestock owners who also raise crops and want to improve soil fertility. In Mali's Sahel this was usually not the case.

The Mission introduced two quite different conservation technologies in **Jamaica** under two different projects. Construction of terraces with the use of heavy equipment, under the Integrated Rural Development project (1977–84), was expensive, complex, and clearly inappropriate. (Some farmers, having to remove crops for construction, actually lost productive land.) Planting perennial trees by manual labor, under the Hillside Agriculture project (1987–97), has been relatively inexpensive, simple, and familiar to most farmers.

In the **Philippines** a technique known as sloping agricultural lands technology has enabled farmers to produce crops without damaging the natural resource base. This technology involves cultivating agroforestry hedgerows along hillside contours. The hedgerows (between which lie "alleyways" planted in crops) help stop soil erosion, improve soil fertility, and reverse degradation of the infertile, steep slopes of the nation's uplands.

In **Nepal** no single technology was adopted widely, probably because improved practices that were introduced (composting, tree-planting, gully erosion control, and stall-feeding of livestock) did not generate large economic benefits. They did contribute, though, to a noticeable but not dramatic improvement in yields and to a reduction in erosion.

Education and Awareness

In all five countries, the effect of environmental awareness campaigns—exhibitions, posters, technical bulletins—was difficult to assess. There was little evidence such campaigns had much effect, one way or the other, on the rate of adoption of the conservation technologies introduced under any of the projects. Farmers took up technologies not to avoid potential long-term negative effects of soil erosion but to achieve short-term economic benefits.

However, word of mouth, site visits, and experiential learning were crucial in educating farmers about specific technologies being introduced. This was often done through training and institution building and, at the local level, by encouraging participation.

Institution-Building

The extent to which institutions (such as farmers associations) functioned well and local populations participated effectively helps explain why some programs were more successful than others. In **the Gambia** and the **Philippines,** the Missions encouraged local participation and strengthened local communities, nongovernmental organizations (NGOs), and farmers associations. These local groups turned out to be important vehicles for disseminating new technologies, constructing and maintaining conservation infrastructure, distributing inputs (such as seeds and fertilizer), and marketing outputs (rice and other harvests).

Similar efforts were made in **Mali** (village-level organizations), **Jamaica** (local management committees), and **Nepal** (first *panchayats* [local councils], then user groups and NGOs). However, the effectiveness of institution-building in these programs was limited. Even in the Gambia and the Philippines, where strong institutional development took place, sustainability of the programs requires continued funding—an uncertain proposition.

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Policy Environment

Appropriate economic policies were more important in Mali and the Philippines than in the Gambia, Jamaica, and Nepal. In **Mali,** USAID helped reduce fertilizer subsidies, giving farmers an incentive to use organic fertilizers, cheaper and more environmentally friendly than chemical alternatives. In the **Philippines** the Mission helped the government carry out a significant policy shift under which individual farmers gain 25-year rights to public land in upland areas. Those rights encourage them to participate in, and benefit from, the conservation program.

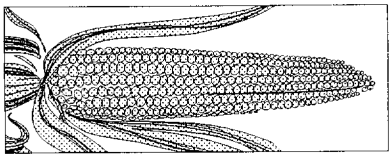
Program Impact

Although results varied among countries, most programs have resulted in significant socioeconomic and environmental benefits. However, indicators used to assess impact were not as rigorous as might have been desired. In part this was because baseline data needed to measure biophysical and environmental change stemming from adoption of improved practices had not been collected (often because they are expensive and time consuming to collect).

In addition, environmental programs, by their nature, require a relatively long period to show impact. Nonetheless, it is well known that these improved practices have significant economic and environmental benefits, and if farmers adopt them on many of their fields, a positive impact is likely.

Socioeconomic Impact

In most countries, the economic impact was impressive. In **the Gambia,** rice yields increased by 108 percent. They rose to 2.7 tons a hectare from 1.3 tons within one or two seasons after saltwater intrusion dikes and water retention



dams were constructed. In **Mali,** millet and sorghum yields increased by at least 10 percent in fields where rock lines had been constructed. In **Jamaica,** coffee production increased from less than 20 boxes to almost 30 boxes an acre, and cocoa production increased from 8–10 boxes to about 30 boxes an acre. In the **Philippines,** as well, it was estimated farmers implementing sloping agricultural lands technology realized yield increases of 300 percent after several years of cultivation. And in **Nepal,** improved water management enabled farmers to double- and triple-crop their fields, leading to a doubling or tripling of yields.

Social benefits accrued as well. In **the Gambia,** for example, the conservation infrastructure ended flooding in the village of Njawara. And in **Jamaica** the social security of the beneficiaries improved, because coffee and cocoa trees provide an annual source of income over 15 to 20 years.

Environmental Impact

The story is similar for environmental benefits. In **the Gambia** the conservation structures protect 15 percent of lowland rice-growing areas from salinization; they protect 1 percent of upland farming areas. In **Mali,** construction of rock lines has decreased soil surface erosion, increased water retention, and improved the buildup of soil cover.

In **Jamaica** more than one million coffee and cocoa trees have been planted and more than two million trees resuscitated on nearly 7,000 acres of hillside land. In addition, various soil erosion control structures have been introduced, including ditches, gully plugs, grass barriers, wooden barriers, and plant basins. Increased tree-planting combined with conservation infrastructure has helped reduce soil losses on Jamaica's highly erodible steep hillsides.

At most project sites in the **Philippines,** adoption of sloping agricultural lands technology has increased terrace formation and helped stabilize the soil. In **Nepal** some farmers are using multipurpose trees and fodder grasses and legumes to stabilize slopes. They are using manure obtained from stall-feeding their livestock to improve soil fertility.

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Program Performance

A program is effective if it reaches the population it intends to benefit. That seems to have been the case with the Agency's sustainable agriculture programs. In **the Gambia,** from 1983–84 to 1992–93, 140 villages and 30,000 people were positively affected by soil and water conservation activities supported by USAID. Because women are the rice growers in the Gambia, they were the primary beneficiaries.

In **Mali** only 2 percent of the land is arable. That land is concentrated in the fertile Upper Niger River Basin, in the southern part of the country, and the program directed its efforts to that area. No particular groups were targeted, except through establishment of 500 literacy centers. Of these, 20 percent were for women. Literacy and numeracy are seen as essential for developing effective cooperatives and other local institutions.)

Although the majority of hillside farms in **Jamaica** are small, the Hillside Agriculture project did not deliberately attempt to reach the smallest, or the poorest, farmers. Instead, the selection process favored young, dedicated farmers who had secure land tenure. As a result, marginal farmers (including widows and other women) were not necessarily—indeed, were infrequently—selected as beneficiaries. Nonetheless, of farms selected, there is no evidence the husband has benefited more than the wife, or vice versa. Income has been treated as family income and shared between the two.

USAID efforts in the **Philippines** targeted one of the poorest regions of the country, where the people for the most part had been overlooked by government programs. Because sloping agricultural lands technology requires only small amounts of money, virtually any farmer with land can participate. The **Nepal** program targeted those with a predominant role in agriculture. These tended to be women and members of disadvantaged groups.

Benefits of the programs generally fell short of costs, although the evidence supporting this generalization is mixed. An excellent economic analysis of the program in **the Gambia** showed that although the benefit/cost ratio was less than 1 over the 13-year project period, the program would break even in 2006. The original economic analysis of the Hillside Agriculture project in **Jamaica** estimated the internal rate of return at 9–22 percent, but a recalculation using more realistic assumptions for coffee yields indicated a rate of return of 6–18 percent, and estimated project benefits were cut almost in half. In the **Philippines,** the technology had not spread widely enough for benefits of the program to equal costs. No economic analyses were carried out for programs in **Mali** and **Nepal,** but there was little doubt the benefit/cost ratios would be negative in both cases.

It is important to keep in mind that each of the five programs was meant to serve as a model that could be extended broadly throughout the host country. However, significant program expansion occurred in only one program, in **the Gambia.** In most instances the model or pilot approach was ultimately applied to a much smaller impact area than intended, so that the cost per unit of land was relatively high.

The conservation technologies introduced in all five countries are replicable. That is, the practices work well, are not complicated, and can be successfully extended to other areas with similar environmental problems and agroclimatic conditions. Moreover, they do not require a large investment. However, the institutional sustainability of these programs at the village level is questionable.

Conservation structures, when installed, should cover fairly large areas, usually most of the sloping fields of an entire watershed. This requires villages to organize farmers working adjacent fields to undertake this task, and the ability of villages to do this varies. In addition, institutions such as NGOs, government extension services, or the private sector must be in place to train farmers in the use of new technologies and practices and to supply agricultural services and inputs associated with the new technologies. Inadequate institutions, especially local ones, are the weak link here. They jeopardize the long-term sustainability of soil and water conservation programs.

Management Recommendations

Four management recommendations emerge from the evaluation:

1. *Demonstrate economic benefits.* Introduce conservation technologies that yield significant economic (as well as environmental) benefits in a relatively short time.

2. *Use simple technology.* Introduce conservation technologies that a) are simple and easy to maintain, b) place minimal demands on labor, c) require few changes in existing practices, and d) are relatively inexpensive.

3. *Support local institutions.* Support and strengthen local institutions and organizations that supply inputs, technical advice, and markets to help ensure the sustainability of conservation programs. (To the extent these institutions already are strong, so much the better.)

4. *Ensure secure tenure.* Support soil and water conservation programs only when intended beneficiaries have secure access to land.

This Evaluation Highlights, *by Donald McClelland of USAID's Center for Development Information and Evaluation (CDIE), summarizes the findings of the study* Agriculture and the Environment: A Synthesis of Findings, *USAID Program and Operations Assessment Report No. 18, PN–ABY–224, by the same author. The synthesis report and this Highlights (PN–ABY–230) can be ordered for a nominal fee (free to USAID employees) from the DISC, 1611 N. Kent Street, Suite 200, Arlington, VA 22209–2111; telephone (703) 351–4006; fax (703) 351–4039; Internet docorder@disc.mhs.compuserve.com. This report is also available electronicallly on the Internet, at http://www.usaid.gov under CDIE Online. Editorial and production services provided by Conwal, Inc.*

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